International Journal of Innovative Computing, Information and Control
Volume **3**, Number **4**, August **2007**

ICIC International ©2007 ISSN 1349-4198
pp. 873–885

OPTIMAL STATE-FEEDBACK CONTROL OF TIME-VARYING TS-FUZZY-MODEL-BASED SYSTEMS BY USING AN INTEGRATIVE COMPUTATIONAL APPROACH

Wen-Hsien Ho

Department of Medical Information Management
Kaohsiung Medical University
100, Shi-Chuan 1st Road, Kaohsiung 807, Taiwan
whho@kmu.edu.tw

Jinn-Tsong Tsai

Department of Computer Science
National Pingtung University of Education
4-18, Ming Shen Road, Pingtung 900, Taiwan
jttsai@mail.npue.edu.tw

Tung-Kuan Liu and Jyh-Horng Chou

Institute of System Information and Control
National Kaohsiung First University of Science and Technology
1, University Road, Yenchao, Kaohsiung 824, Taiwan
{ tkliu; choujh }@ccms.nkfust.edu.tw

Received September 2006; revised February 2007

Abstract. *This paper considers the quadratic-finite-horizon-optimal control problem of time-varying nonlinear dynamic systems, where the time-varying nonlinear dynamic systems can be represented by the time-varying Takagi-Sugeno (TS) fuzzy-model-based dynamic systems. An integrative method, which complementarily fuses the Legendre series approach (LSA) and the hybrid Taguchi-genetic algorithm (HTGA), is presented in this paper to design the quadratic optimal time-varying-state-feedback (TVSF) controllers for the finite-horizon optimal control problems of the time-varying TS-fuzzy-model-based control systems. A design example of the quadratic optimal TVSF controller for the pendulum system with the vibration in the vertical direction on the pivot point is given to demonstrate the applicability of the proposed integrative approach.*
Keywords: Quadratic finite-horizon optimal control, Time-varying Takagi-Sugeno fuzzy model, Legendre series approach, Hybrid Taguchi-genetic algorithm, Time-varying state-feedback controller

1. **Introduction.** It has been recently shown that the fuzzy-model-based representation proposed by Takagi and Sugeno [1], known as the TS fuzzy model, is a successful approach for dealing with the nonlinear control systems [2-8]. Unlike the conventional modelling approaches where a single model is used to describe the global behavior of a nonlinear system, the TS fuzzy modelling approach is essentially a multimodel approach in which the simple submodels (typically linear models) are combined to describe the global behavior of the nonlinear system. Based on the approach of using the sector nonlinearity in the